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MONTANA COAL GASIFICATION PROJECT

FEASIBILITY STUDY

FINAL REPORT

December, 1976

Prepared For

HONORABLE THOMAS L. JUDGE

GOVERNOR OF MONTANA

Prepared By

GOVERNOR'S TASK FORCE ON COAL GASIFICATION

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FOREWORD

MONTANA'S PRESENT NATURAL GAS SUPPLY
PROBLEMS AND ALTERNATIVES

Montana natural gas consumers are serviced primarily by two major utility corporations. The Montana Power Company directly accounts for approximately 64% of total state natural gas retail sales, with an additional 9% of sales distributed through smaller utilities, in the central and western two-thirds of the state. The remaining 27% of sales are made by the Montana-Dakota Utility Corporation in the eastern third of the state.[1]

Gas Supply

The Montana Power Company (MPC) either produced or purchased 14.4 billion cubic feet (BCF) of natural gas from Montana sources in 1975. This amount represented about 25% of central and western Montana's total demand in that year. The remaining 75% of the 1975 natural gas supply for the MPC distribution system was obtained from Canadian sources in two Albertan fields:

- The Carway field in southwestern Alberta for which existing contracts allow purchases of 29.2 BCF per year. These contracts begin to expire in 1985.

- The Aden field in southeastern Alberta which have historically provided 18-20 BCF per year. Current permits allow export of 5 BCF between May 1976 and May 1977. It is anticipated that all exports from this field will be terminated in May 1977.

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[1]Montana's Natural Gas Situation, Montana Energy Advisory Council (MEAC), June, 1976.

The importation of Canadian natural gas to Montana began in 1952. These imports steadily increased to an annual maximum of 50 BCF in 1973 and have decreased since then to 42.2 BCF in 1975. It is expected that the import total will show a further decrease to 34.2 BCF in 1976. Canadian natural gas imports to Montana in 1977 are projected to be 29.2 BCF, if a lease extension of 5 BCF is not accepted, and would result in a 43.6% decrease in fuel availability over a four-year period.

Canadian lease depletion can be accomplished by two methods. The first method is through time in that each lease has a negotiated expiration date. If the volumes specified in the leases have not been extracted by the expiration date, further production is not permitted unless a time extension is arbitrated. The second method of lease depletion is by volume. If annual volume extraction increases from planned levels, the total volume under lease will be depleted before the lease's expiration date. For example, if a natural gas lease is for 100 BCF and 10 years duration, an annual extraction rate of 10 BCF per year will result in simultaneous volume depletion and lease expiration. If due to increased demand production is increased to 20 BCF per year, the lease will be terminated in five years by volume depletion. In effect, the scheduling of Canadian natural gas imports is a balancing problem. By ensuring the adequacy of supply in the near-term, the dimensions of shortage in the mid-term becomes more critical.

The Montana natural gas supply situation is similar to other northern tier states problems with Canadian resource dependency. However, the order of magnitude of the Montana dependency presents a relatively unique and potentially critical point of divergence.

Canadian export policy, as established by the Canadian National Energy Board, is based upon production surpluses that exceed identified Canadian national requirements. The natural gas export regulations of Alberta, created in the Gas Resources Preservation Act of 1956, established a goal of "preservation and conservation of the oil and gas resources of the Province and to provide their effective utilization with regard to the present and future needs of persons within the Province." Under this law, other Canadian provinces cannot import gas from Alberta unless there is an identified exportable provincial surplus. However, Alberta on its own initiative has been generally willing to export gas to other consuming areas.

The policies of the Canadian National Energy Board (NEB) are the greatest problem for Montana regarding natural gas imports. The NEB forecasts anticipated Canadian national gas demand in twenty-five year periods. These forecasts take into account trends in discovery and production before assessing and estimating exportable surpluses, and are calculated on a national scale reflecting total internal Canadian demand.

The Canadians have indicated to Montana that reliance upon imported gas is not in the best interest of the state,

and, further, that as licenses and agreements expire, Montana should not expect contract extensions.

As leases are depleted and/or not renewed, more pressure is generated to extract greater volumes from remaining leases to compensate for decreased resource availability. When production in these remaining fields increases, volume depletion is accomplished more rapidly and, therefore, leases currently extending to 1993 could be depleted as early as 1986.

Gas Prices

The Montana Power Company is an intrastate utility that distributes its energy totally within Montana. As such, it is not subject to the regulations, including rate setting, of the Federal Power Commission (FPC). Montana-Dakota Utility Corporation is an interstate energy carrier and is, accordingly, subject to FPC regulation.

Canadian natural gas pricing policy is based upon fuel costs established by other fuel exporting nations. In theory this means that Canadian prices should not be less than the price of other foreign energy supply alternatives. This objective is achieved by establishing price on an equivalent British Thermal Unit (BTU) basis with other fuel exporting nations. Since the major suppliers of fuel to the United States are the Organization of Petroleum Exporting Countries (OPEC), increasing Canadian prices should be expected to follow rises in OPEC prices.

The at-the-border price of Canadian natural gas, which was the source of approximately three-fourths of the Montana

Power Company's supply in 1975, has increased from 23 cents a thousand cubic feet (MCF) to $1.60 MCF in the past four years. This price will further increase to $1.94 MCF in January, 1977 and, since Canadian pricing policies are based on OPEC fuel costs, further price increases can be anticipated in the future.

Under FPC price ceilings, the well-head price of domestic natural gas was set at $.51-$.68 MCF through July, 1976.[2] On July 27, 1976, the FPC permitted an increase in well-head price to $1.42 MCF for "new" natural gas, which is defined as gas produced after January 1, 1975. Montana-Dakota Utility Corporation requested a rate increase from the Montana Public Service Commission in November, 1976, that would allow a pass-through of this increased well-head cost to the consumer.

Montana Natural Gas Alternatives

In-State Production

Montana possesses significant reserves of resources. Copper, wood, coal, gold, and silver can be found in quantities varying from limited to abundant. Montana, however, does not possess large reserves of either oil or gas which has in the past forty years fueled our cars, homes, small businesses and industries. The following graph depicts economically recoverable coal, oil, and natural gas reserves

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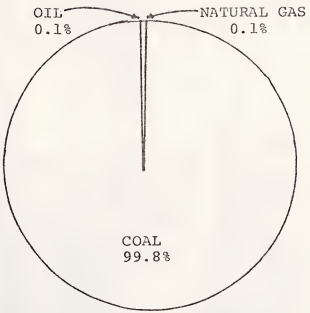
[2] MEAC.

in Montana.[3]



A study conducted under the auspices of the Montana Energy Advisory Council provides some hope that additional natural gas can be secured in Montana. The final report of this study entitled, "Undiscovered Natural Gas Resources of Montana," attempts to calculate the natural gas potential of the state. A Steering Committee generated estimates of what they believed to be a low resource estimate, that would correspond to a 95% probability that the resource existed, and a high resource estimate with a 5% probability that there is at least that amount. A model estimate, which the estimator associates with the highest probability of occurrence, was also generated. These three estimates were then divided by three to derive a statistical average of Montana's undiscovered natural gas resources.[4]

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[3]MEAC Montana Historical Energy Statistics.

[4]MEAC, "Undiscovered Natural Gas Resources of Montana," pp. 11, 12.

Below is a table identifying the natural gas estimates of the Steering Committee.

MONTANA UNDISCOVERED RECOVERABLE RESOURCES
OF NATURAL GAS

Province	Montana Estimated (Tcf)	%
Montana Folded Belt	5.00	70.82
Sweetgrass Arch	1.00	14.17
Central Montana Uplift	0.20	2.83
Williston Basin	0.36	5.10
Big Horn Basin	0.25	3.54
Powder River Basin	0.25	3.54
Total	7.06	100.00

The Montana folded belt extends from the eastern portion of Glacier National Park through the Bob Marshall Wilderness to Livingston, Montana. It is similar in geologic structure to natural gas producing areas in both Wyoming and Alberta. The Steering Committee indicated that they believed this area could have an undiscovered resource potential of 5 trillion cubic feet. This accounts for almost 71% of their total in-state resource estimate. However, the areas where they indicate the greatest potential exist within either Glacier National Park or adjacent to the Bob Marshall Wilderness in an area that has been proposed as critical grizzly bear habitat. Further, the study quotes J. L. Cannon, Jr. in an assessment of hydrocarbon potentials in the area:

> "The Montana Disturbed Belt has been an expensive disappointment for oil companies for nearly 70 years. Exploration has been conducted nearly continuously, at a low level, for most of that time. In the decade 1950-1960, major oil companies made a concerted effort to find commercial hydrocarbon accumulators and failed. Activity today is again at a low level."
>
> "Primary objectives have been the unexposed updip edges of Madison thrust plates along the eastern edge of the mountain front. Seismic mapping and drilling along the east border of Glacier National Park have defined few, if any, Madison thrust sheets that extend significantly eastward beyond the park boundary in the United States. Farther south along the east front of the Sawtooth Range, several wildcats have tested buried Madison thrust sheets in a very narrow strip, a mile or two wide, just east of the first Madison surface exposures. South of the Sawtooth Range in the vicinity of the Missouri River, intensely deformed Mezozoic clastic rocks confirm that compression and thrusting are still the dominant tectonic features. The few dry holes in this area have not been encouraging. Present seismic techniques are believed to be capable

of providing adequate structural definition and many of the dry holes appear to have been favorably located."

Factors that appear to diminish the hydrocarbon potential of the area are: (1) Exposure of source and reservoir rocks in the Sawtooth Range, essentially excluding that area from possible production. (2) The apparent absence of good source rocks in addition to previously mentioned factors such as road network and drilling in Glacier National Park and the Bob Marshall Wilderness Areas.

"The hydrocarbon potential of the Ovethrust province in northern Montana surely cannot be rated as very good in view of the lack of a single producing field after 70 years of exploration. Yet the area is sufficiently large enough to contain millions of barrels of oil or equivalent volumes of gas, and drilling density is low."

James Nybo, Energy Research Coordinator for the Montana Energy Advisory Committee and Steering Committee member, has said that "This report does not say that the gas is there. Evidence indicates that it may be there. The study does not consider the economics of exploration and development. We still have no information as to what share of this gas, if it does in fact exist, will prove to be economically recoverable. Furthermore, we have yet to come to grips with such volatile issues as drilling in ecologically fragile and legally protected areas including national forest lands, the Bob Marshall Wilderness and Glacier National Park."

Although a potential exists for increased in-state natural gas production, the report's findings have not been substantiated. This undiscovered resource might not exist or may exist in the quantities estimated by the report. If a resource does exist, it may remain undiscovered.

In-state natural gas production, if large reserves are discovered, could increase. However, the information presently available does not indicate that this will be the case, only that a potential exists.

Proven Montana natural gas reserves are approximately 929.99 BCF. The ratio of reserves to production, at 1975 levels, was 17 years (i.e., Montana's proven or demonstrated gas reserves will be exhausted in 17 years at 1975 production rates).

Canadian Supplies

It does not appear at this time that Montana will have the opportunity to negotiate new contracts or renegotiate permits for continued natural gas export. All indications point to a termination of natural gas exports from Canada between 1985 and 1990.

Alaska-McKenzie Valley Pipeline

A proposed natural gas pipeline from the north slope, McKenzie Valley region of Alaska is being pursued by the Artic Gas Corporation. This system would transport 9 BCF per day of natural gas to the east and west coasts of the U.S. The eastern leg of the pipeline, as it is presently envisioned, would traverse the extreme eastern corner of Montana. Under present agreements, Montana could receive

approximately 5 BCF per year from this source. There are, however, two competing planned projects that would impact this proposal's implementation. One would transport natural gas to Valdez, Alaska, where it would be liquified and shipped via tanker to Southern California. The other proposal would develop a gas pipeline through Canada, but take an alternate route eastward and by-pass Montana. The Artic Gas Corporation estimates that its pipeline would cost 9 billion 1976 dollars. Currently the proposal is having trouble with: 1) traversing the Alaska National Wildlife Range 2) its socio-economic impact on the natives of the Northwest territories, and 3) the generation of 9 billion dollars for construction. The cost of gas from this source is currently estimated to be between $3.00 - $3.50 per thousand cubic feet at the Montana border.

Wyoming and Other Interstate Sources

It does not appear that Montana can receive additional supplies of natural gas from out-of-state domestic U.S. sources. Most of these resources are already committed to other consuming areas.

Montana is not unique in its natural gas supply situation, only the degree and the relative immediacy of the problem differ. The midwest and the northeast portions of the U.S. will be experiencing similar natural gas problems. For those reserves that are not already committed, extreme competition exists between utilities. Montana does not have a strong negotiating position.

INTRODUCTION AND EXECUTIVE SUMMARY

The State of Montana is faced with a diminishing and uncertain supply of natural gas, especially Canadian gas imports which the central and western portions of the state are vitally dependent upon. In response to this impending energy crisis, the Governor of Montana established the Montana Task Force on Coal Gasification (MTFCG) in June, 1975, to investigate various methods of alleviating the problem. After a period of preparatory work, including the investigation of alternate energy sources, the MTFCG initiated a formal coal gasification feasibility study project in early 1976. This final report summarizes the work accomplished during the study project and its results, conclusions and recommendations.

The Coal Gasification Feasibility Study was performed by the Montana Trade Commission (MTC) as an agent of the Montana Task Force on Coal Gasification. The MTC retained a number of consultants for assistance in accomplishing specific study tasks. These consultants and their respective areas of responsibility are identified below:

The Dravo Corporation	Coal conversion process review, evaluation and selection recommendation.
American Lurgi Corporation	Conceptual design of a Lurgi process plant.
The Lummus Company	Conceptual design of a Lurgi process plant support facilities.
Montana Energy and MHD Research and Development Institute, Inc. (MERDI)	Gas price-demand and site selection trade-off studies.
Dillon, Read & Co., Inc.	Development of alternative financial plans.
Leroy Love (Wood, Dawson Love and Sabatine)	Bond counsel
Donald Robinson (Poore, McKenzie, Roth, Robischon and Robinson)	Legal counsel
AVCO Montana Energy Systems	Technical management support

Statement of Problem

The OPEC oil embargo in the fall of 1973 produced a sudden awareness of the role of energy in the United States. Cheap and available energy previously provided few restraints on the American lifestyle and its supporting industries. Fast economic growth was accompanied by an ever accelerating rate of energy consumption. This spiral of demand took place without serious concern over the availability of energy resources.

In many ways, the energy situation in Montana is a miniature reproduction of the nationwide energy picture. The state is confronted with an impending shortage of natural gas and crude oil because of its dependence upon a foreign resource (Canada).

In past years the demand for natural gas in Montana was similar to that of the national pattern. However, since 1970 the consumption of natural gas in the state has been declining despite its past low price, a rate structure that encourages increased consumption and its widespread use. Although per capita use of natural gas in Montana is higher than the national average, due primarily to highly energy intensive industries and northern latitude climate, its declining rate of consumption is counter to the national trend of continued growth. The decline in consumption is most likely due to both limited economic growth and the increased cost of Canadian imports.

Natural gas consumption in Montana has decreased from 82+ billion cubic feet (BCF) in 1970 to 75+ BCF in 1975. This demand was met by Canadian imports which provided approximately 60% of the total supply and in-state production which provided the remainder. A planned systematic curtailment of the Canadian supply has resulted in a decrease of Montana imports from 49 BCF in 1973 to a current level of 34.2 BCF. Canadian exports to Montana are

scheduled to be further reduced to 29 BCF in 1977 although an opportunity may exist to maintain imports at the 34.2 BCF level. Further reductions are scheduled until complete curtailment of exports is reached in 1987. Further, the recent history of curtailed Canadian natural gas supplies has been accompanied by escalating costs over the past four years. During this period the at-the-border price of Canadian natural gas has increased from 23 cents per thousand cubic feet (MCF) to $1.60 MCF. This price will further increase to $1.94 MCF in January 1977 and, since Canadian pricing policies are based upon OPEC fuel costs, further price increases can be anticipated.

Canadian natural gas is consumed only in central and western Montana and provides approximately 75% of the supply in these areas. The eastern third of the state is serviced by a production and distribution system which is comprised of interstate flows of natural gas acquired in Montana, North and South Dakota and Wyoming and distributed to consumers located in those states by Montana Dakota Utilities. Future gas supplies for this latter market segment is dependent, in part, upon discovery of additional in-state reserves. Domestic gas prices in eastern Montana will also increase in the future

due to Federal Power Commission price ceiling adjustments.

Future demand for natural gas in Montana is difficult to project and will depend upon the state's economic growth, success of energy conservation efforts, the amount of conversion to other sources of energy, rates of exploration and discovery, and the price of gas which will impact all of the preceding factors. The "most likely" projections arrived at in this study indicate an annual Montana gas consumption of approximately 55-60 BCF in the year 2000. This is a significant requirement. It is equal to two-thirds of the present total state annual demand, or more than the current total annual demand for central and western Montana. In any case, there will be a deficit between demand and projected supply. If this deficit is large, gas supplies to industry will be curtailed, possibly resulting in increased unemployment, and forced reductions in consumption by the commercial and residential sectors could also result.

Alternative Solutions

Montana is fortunate in that its diminishing supply of natural gas is estimated not to become critical until sometime between 1985 and 1990. However, there is no single, simple and readily-available solution to this problem. If

the serious impacts of a natural gas shortage are to be avoided, steps must be taken now to develop economically and environmentally acceptable solutions.

A search for alternative solutions to the impending natural gas supply shortage in Montana has been underway since identification of the problem. Future energy options can be considered in three time frames of reference: near-term, mid-term, and long-term.

Near-Term (Present - 1985)

For the next decade, Montana will have to depend primarily on conservation and development and expanded use of its existing nonrenewable fuel resources. More efficient use of existing energy supplies and conservation measures to reduce energy consumption in the future must form the base of a state energy policy. Energy consumption based upon conservation in all usage sectors should determine projected demand. Economic incentives may promote a degree of conservation; however, based upon past experience, the impact of conservation on future energy demand should not be overestimated, particularly in the residential-commercial usage sector.

Economic incentives, in the form of tax relief and

higher well-head prices, can result in: increased exploration leading to discovery of new sources of natural gas; production by wells presently considered uneconomic or marginally economic; and enhanced recovery by stimulation techniques.

Conversion from natural gas to other sources of fuel, primarily electricity or direct burning of coal, can extend the supply of natural gas during this period. Some industrial conversion from natural gas has been completed and/or is currently planned. Whether used directly or converted to electricity, the following penalties of increased coal consumption by present natural gas consumers should be recognized:

- Capital costs of individual end-user conversion from natural gas to direct-fired coal or electricity.
- Capital costs of individual end-user pollution control systems required by conversion to direct-fired coal systems.
- Capital costs of large-scale increases in coal-fired electrical generation capacity and required pollution control systems.
- Capital costs and environmental impact of large-scale increases in electrical distribution systems.
- Increased natural gas costs due to support of existing pipeline distribution system by fewer users.

The higher capital costs described above will be very large and paid primarily by the end-user through higher energy prices. Utility company capital investment will be passed on to end-users in the form of higher rates.

Wood, solid waste products and hydroelectric are potential sources of fuel during this period; however, their impact on total available energy supplies is thought to be minimal.

Mid-Term (1985 - 2000)

Energy options, in addition to remaining in-state coal and natural gas reserves, most likely to be available in the mid-term include: geothermal, solar heating and cooling, wind, nuclear, Alaskan natural gas and synthetic fuels from coal.

For reasons of technical development, resource availability, cost and suitability for large-scale commercial use, geothermal, solar heating and cooling and wind energy systems will not be significant factors in the solution of Montana's energy problem in this time period. Individual or some local requirements may be satisfied by energy sources of these types; however,

they will collectively satisfy a small percentage of total state demand.

Nuclear (fission) energy will continue to be an alternative; however; large-scale conversion to nuclear electric power would incur most of the penalties previously described for conversion to coal-fired electric power plus its own inherent problems of environmental impact, waste disposal and public concern (assuming these latter problems are not satisfactorily resolved in the interim).

A natural gas pipeline between the North Slope, McKenzie Valley Region, of Alaska and the United States mainland has been proposed. If constructed, this pipeline would transport natural gas to the east and west coasts of the United States. Under present agreements, Montana would receive five billion cubic feet per year at $3.00 to $3.50 per thousand cubic feet from the eastern leg of the line which would pass through the northeastern corner of the state. This pipeline, however, faces competition from two other proposals, neither of which would benefit Montana.

Synthetic fuels from coal, specifically synthetic high BTU natural gas and chemical by-products, present a potentially attractive alternative as a partial but significant solution to Montana's energy supply problem

during this period. The technical risk and capital cost of a coal gasification plant are balanced or outweighed by the following factors:

- Gas costs could be competitive with alternative sources of natural gas (Artic Gas Project; deep wells, etc) and other energy sources (electricity, fuel oil, etc).
- Utilization of the existing natural gas distribution pipeline system in Montana
- State control of an assured energy source
- Elimination of user conversion requirements
- Environmental acceptability
- Relatively efficient utilization of state coal and water resources

Accordingly, high BTU coal gasification was selected for a detailed feasibility study which is the subject of this report.

Low BTU gasification is an alternative synthetic fuel option. Its applicability, however, is limited to major industrial site or localized (community) use due to its high transmission costs.

Long-term (2000 and beyond)

The energy resources and conservation measures which are the mainstay of energy planning throughout the near-term and mid-term will diminish in their capacity to

support further energy growth in the long-term. After the turn of the century, Montana will probably rely upon a mix of electrical energy and renewable energy sources. The required technologies necessary to realize this transition are currently unproven and will require long lead times to develop. All presently have some serious technical, environmental or cost problem.

Coal Gasificatien Feasibility Study

The objective of the feasibility study was to provide information, results, conclusions and recommendations to the MTFCG and other appropriate decision makers in Montana that would indicate the potentials and problems associated with the production of high BTU synthetic natural gas and process by-products at a Montana-located facility.

The scope of the feasibility study can be summarized as follows:

- Analysis, evaluation and ranking of coal conversion processes
- Gas price/demand trade-off studies
- Determination of project financial requirements and preparation of financial plans

- Preparation of draft legislation to provide the state of Montana with statutory power to participate in joint ventures with the private sector, and enable the issue of revenue bonds
- Evaluation of plant site alternatives
- Definition of environmental requirements and responsibilities and environmental impact assessment
- Liaison with the Montana Congressional Delegation and federal and state agencies

A development plan to identify and delineate all project activities (feasibility study through commercialization), their interrelationships and sequences of accomplishment and critical decision points, was prepared during the feasibility study. This plan divides the project into a number of phases to permit a continuing evaluation and control of its progress, and establishes decision points at critical milestones to provide for approval prior to commitments to succeeding project phases.

The Montana coal gasification project has been structured into seven areas of interrelated activity critical in a determination of project viability: technical, financial, legal, environmental, site, federal relations and public concern. In addition, a project management activity provides the direction, supervision, control, administration , coordination, and liaison for project efforts.

Technical Activity Area

The objectives of the technical activity area were to analyze and evaluate the technical and economic factors related to determining the feasibility of high BTU coal gasification in Montana, and to recommend the specific type and size of coal conversion process facilities necessary to satisfy projected cost/demand economic criteria. Accordingly this activity area was divided into two parts: process evaluation and economic analysis.

Process Evaluation

The technical process evaluation and selection study to compare the trade-offs involved with various coal conversion processes consisted of four parts:

- Conceptual design of a reference-scale 150 MMSCFD synthetic natural gas (plus synthesis gas equipment for 1,000 tons/day ammonia) Lurgi process plant and support facilities to Montana requirements.
- Analysis, evaluation and ranking of first and second generation coal conversion process reference-scale plants as related to Montana requirements
- Recommendation of a specific type and size of coal conversion process facility to satisfy Montana requirements
- Preparation of preliminary specifications for the recommended (and approved) process

The technical evaluation of processes included analysis of the following factors:

- Coal characteristics and quantity requirements
- Water requirements
- Feedstock utilization
- Gas product quantity, quality and cost
- Generation of co-products and by-products
- Environmental concerns
- Rapidity of plant design and construction
- Process reliability
- Support energy requirements

Twenty-one processes were included in the initial preliminary evaluation. By eliminating those processes that have not reached the pilot plant stage, and selecting those processes that have the ability to handle lignite or subbituminous coal and are in an advanced state of technical development, the number of processes to be further considered was reduced to eight:

- Lurgi
- Koppers-Totzek
- Winkler
- CO2 Acceptor
- HyGas
- COGAS
- Texaco
- Babcock and Wilcox

Block diagrams, material balances, thermal efficiencies, schedule and cost data were prepared for the processes listed above. More detailed cost data for the three processes with the highest thermal efficiencies (CO2 Acceptor, HyGas and COGAS) were then prepared by Dravo for comparison with Lurgi process costs furnished by Lurgi and Lummus. The other four processes were eliminated from further consideration.

Following is a cost summary of the three selected processes. All estimates are for a plant with a daily output of 150 MMSCFD plus synthesis gas for 1,000 tons of ammonia:

PROCESS SELECTION STUDY
SNG FROM COAL
FOR
MONTANA TRADE COMMISSION

COMPARISON OF PROCESSES

PROCESS DATA	CO_2 ACCEPTOR	HYGAS	LURGI
Raw Coal, TPD	17,946	21,434	22,425+
Oxygen, TPD	--	2,229	3,590+
Raw Water, GPM	5,847	7,121	6,080+
Purchased Electric Power, KW	90,100	91,200	58,000+
Area Estimate, Acres	275	285	285
SNG Product, Billion Btu/D	142.21	152.99	143.50+
Ammonia Synthesis Gas, TPD equivalent NH_3	1,000 1,000	1,000 1,000	1,000+ 1,000+
By-product Sulfur, TPD	68.1	81.4	80+
By-product Sulfuric Acid, TPD	--	--	110+
By-product Ammonia, TPD	90	68	107+
By-product Coal Oil, Tar & Naphtha bbl/d	--	--	3,625+
Syncrude, bbl/d	--	--	--
Light Hydrocarbons, TPD	--	830	--
Crude Phenols, bbl/d	--	--	616+
Operating Labor	210	261	256+
Total Plant Investment, $MM	469.8	454.6	500.0*
Gas Cost, $/MM	3.08	2.62	3.11
First Year Gas Cost, $/MM Btu	3.54	3.07	3.61
Schedule Requirements, months	84	87	77+
O.A. Thermal Efficiency, %	64.8	69.8	60.1**
Technical Evaluation Ratings (Top Rating = 75)	45	45	72
Overall Evaluation Ratings (Top rating = 80)	60	64	65

*Value derived by deleting the NH_3 synthesis section from the Lummus Estimate.

**Value derived from Lummus Estimate by substituting for purchased power a coal equivalent of 10,000 Btu/KWH instead of heat equivalent of 3413 Btu/KWH.

+Lurgi/Lummus Estimate.

Economic Analysis

The objective of the economic analysis was the compilation, analysis and evaluation of the economic factors related to determining the feasibility of high BTU coal gasification as an energy source in Montana. Determining the demand for synthetic natural gas (SNG) essentially is a balancing problem. The SNG demand will consist of the additional production required to balance natural gas requirements with the supplies available. Thus, the demand for and supply of natural gas must be determined before the demand for SNG can be projected. Further, natural gas cannot be considered alone as it competes with other fuels. Conversion of industry, and other usage sectors, from gas to coal and electricity are possible and can significantly affect the demand for natural gas. The cost of SNG will be different from that of natural gas and other energy sources and this will also be a significant factor in determining its place in the energy market. Although blending will have a significant effect upon gas cost at its end use, this was not considered here.

The analytical approach used was to develop a model of Montana's economy on which energy demands can be based. The primary modeling technique utilized was dynamic systems simulation using a model similar in concept to the Oregon State Simulation Model. The model is composed of several

sub-models each dealing with a particular area of the economy: demographic, land use, economic activities (agriculture, logging, mining, oil and gas, capital investment and employment) and energy. The industrial and commercial demands for energy were based upon the levels of activity in these sectors of the economy while residential demands were based upon the number of households and their income. In addition, the effects of inter-fuel competition and conservation were considered.

The methodology chosen deals with the forces causing change in the economy and is considered well suited for the transients which are likely in Montana's future. It also allowed the model to be based closely on the actual processes and actions which occur in Montana's economy. The dynamic simulation was combined with input/output analysis in determining levels of economic activity.

The study indicates that:

1. A baseline projection, assuming little residential energy conservation, fuel substitutions and a continuation of current policies and practices, that gas demand will be 84 BCF (billion cubic feet) per year in 1985, approximately 95 BCF in 1995 and 89 BCF in the year 2000.

2. If full residential conservation is effected, gas demand is approximately 80 BCF in 1980 declining to 77 BCF in 1985. Peak demand would be experienced in the mid-1990s with a demand of 85 BCF, a 10 BCF savings over

the baseline estimate.

3. Industrial fuel substitutions and conversions to alternate fuels could result in decreasing demand for gas in the year 2000 by 10 to 20 BCF per year.

4. Demand for natural gas is estimated to be affected as follows by price:

	$2.00 MCF Year 2000	$3.00 MCF Year 2000	$6.50 MCF Year 2000
1980	67 BCF	67 BCF	66 BCF
1985	67	56	54
2000	69	55	51

5. In the "most likely" projection, gas demand generally decreases but by the year 2000 Montana consumers will still demand between 50 and 60 ECF per year of either natural or synthetic natural gas.

Financial Activity Area

The financial activity area of the study was concerned primarily with the preparation of financial plans for the funding of a first or second generation process coal gasification plant in Montana. These plans will be a factor in both final process selection and the determination of overall project feasibility.

Financial plan preparation included consideration of the following factors:

- Plant capital and operating cost requirements
- Methods of financing the plant
- Capital sources for financing
- Economic impact(s) of plant financing
- Interface of project financial activities with project legal activities

Financial planning alternatives considered have ranged from 100 percent private sector funding of a first generation process plant to various joint venture scenarios for funding of a second generation process plant.

Federal support of a first generation process plant, if available, will be limited to loan guarantees contained in Synfuels legislation. However, this bill was defeated in the last Congress and its future in the upcoming session is uncertain.

Federal support of a second generation process plant is also uncertain at this time. Conceptual designs of two second generation process (Slagging Lurgi and COGAS) plants are currently in progress under the ERDA Demonstration Plant Program. The future of these projects, after the conceptual design phase, is not clear. A new procurement request from ERDA for design(s) of a HYGAS process gasification plant is anticipated in the near future. Based on information now available, Montana will respond to this procurement opportunity.

Independent of any formal ERDA procurement request, an unsolicited proposal for a HYGAS demonstration-scale plant in Montana will be submitted to this agency early in 1977. Requested federal funding support will include a share of project costs, product price subsidy and a capital cost ceiling.

Legal Activity Area

The legal and financial activities of the proposed project are very closely interrelated and interdependent. This situation is further complicated by the lack of precedents in that coal conversion processing has not been demonstrated in the United States.

Two areas of legal activities have been of concern in the feasibility study:

- Legal aspects of financial activities
- Federal, State and Local regulations and practices

Project financial requirements present a potential need for a joint venture arrangement. In the case of a joint venture sponsor arrangement including state participation, the State of Montana currently has constitutional capability for such participation but lacks the statutory power. Accordingly, as a part of the feasibility study, draft state legislation was prepared to create a state agency responsible for the further feasibility research of coal gasification.

The Coal Gasification and Related Fuels Act of 1977 would create a state agency (Commission) which would be responsible, together with other appropriate state agencies, for control and protection of state interests in a coal gasification project. The Commission would be composed of seven members:

- Governor, State of Montana
- Lieutenant Governor, State of Montana
- Director, Montana Department of Natural Resources and Conservation
- Agricultural representative
- Utilities representative
- Labor representative
- At Large member representing the Montana public

The Commission would be empowered to:

- Retain a professional staff and consultants
- Participate jointly with others in projects
- Enter into contracts. Contracts entered into by the Commission will be in the opinion of the Commission in the best interest of the State.
- Accept and expend gifts and grants from any source
- Employ personnel
- Do all acts and things necessary to exercise the powers granted to the Commission

The Commission would not have the power to:

- Commit the faith and credit of the State of Montana

All laws, rules and regulations of the State of Montana, not mentioned specifically within the legislation, would be applicable to projects engaged in by the Commission including:

- The Major Utility Siting Act
- Zoning Standards
- Environmental Quality Standards
- Air, Water and Solid Waste Emission Controls

Environmental Activity Area

The feasibility study environmental activities focused upon identification of environmental requirements and definition of responsibilities for response to those requirements; preliminary evaluation of key environmental problems; determination of federal and state environmental agency jurisdictions; and, preparation of required preliminary documentation.

The plants for the eight candidate processes considered in the final evaluation were designed so that the identifiable critical pollutants in the effluent streams met federal and state environmental standards in addition to local

environmental standards. These designs incorporate pollution control systems such as acid gas removal systems, units to recover sulfur, stack gas scrubbing, water treatment systems, flares, thermal oxidizers, etc. Final details of the environmental control systems will be developed when detailed material balances for the selected process are prepared and permit applications filed. A compendium of federal, state and local emission standards and precedence of jurisdiction as applicable to Glasgow Air Force Base, Montana, was prepared as a part of the feasibility study.

Permits for land and water use are required by both state and federal governments. In addition to considering environmental standards as critical factors in process and site selection, the proposed project is pursuing a concept of maximum beneficial use of land and water resources to be utilized in conjunction with the facility. As an example of this approach, the use of the facility water source and pipeline transmission system to irrigate a large area of previously unirrigated land, thereby increasing the area's acreage under cultivation and productivity, is a part of the overall project plan.

The filing of a long-range plan is required by the State of Montana for any proposed industrial development anticipated to be on stream within a ten-year period. A

long-range plan for the Montana gasification project was submitted to the Montana Department of Natural Resources and Conservation in April, 1976.

Predating the approval of a construction permit the State requires that an environmental impact statement (EIS) be prepared estimating possible social, economic and environmental disruptions. An average of 24 months is normally expended in fulfilling this requirement. The State Department of Natural Resources and Conservation functions as the prime contractor for this effort. Other state agencies having responsibility to assess impacts in their area(s) of expertise participate as subcontractors. It is anticipated the filing fee to be submitted to initiate preparation of an EIS for the proposed project, in accordance with the State's Major Facility Siting Act, would be between $1.2 and $2.1 million, depending upon the type and size of gasification plant finally selected for construction. Plans are in process to apply for these funds under the recently enacted Department of Defense construction bill appropriation designated for this general purpose. This application will be based upon the selection of Glasgow Air Force Base, Montana, as the plant site.

Site Activity Area

Traditionally, the siting of industrial plants has been dictated by availability and proximity of resources. Cap-

ital factors have predominated over social, economic, and environmental impacts. In order to counter this trend and possible negative ramifications of siting a coal conversion facility in Montana, this project has taken an objective approach to the selection of a plant site by evaluating the merits of siting at a mine mouth location versus a site location (Glasgow Air Force Base) currently possessing an infrastructure, but located in an area relatively remote to coal and water resources.

A mine mouth site has the advantage of minimizing transportation costs by its proximity to coal and water feedstocks. However, a mine mouth location requires the construction of a supporting community including, but not limited to, housing, roads, sewer systems, residential utilities and other amenities required by the community population. When the plant's life has been realized, in most cases, no economic base or incentive remains to support this community infrastructure. This type of "boom-bust" cycle can be avoided if a remote site can be shown to be socially and economically competitive with a mine mouth site.

If a favorable trade off of coal and water resources and their transportation cost exists, socioeconomic problems arising from industrial facility development can be lessened by the remote site's existing population and infrastructure. The utilization of a remote site minimizes lifestyle mod-

ifications and additionally avoids the development of a "company town" totally dependent upon project performance and duration.

An evaluation of gasification plant site requirements, including a trade off study of Glasgow Air Force Base, Montana, versus several mine-mouth site locations in eastern Montana was completed as a part of the feasibility study. Factors considered in this evaluation included land requirements and ownership, proximity of required coal and water resources, socioeconomic factors, environment and product/by-product distribution and marketing.

Federal Relations Activity Area

The Montana coal gasification project has been intimately involved with events at the national level, including a continuing interaction with the federal government, since its inception.

The project has its origin in the potential natural gas supply problem in Montana caused by the Canadian government's natural gas export policy, and the second-order effects of OPEC actions. While having a direct impact on the state of Montana, the broader aspects of these international decisions affect the nations foreign relations and, thereby, the involvement of the federal government. All of the Montana gasification project's areas of activities have been impacted

by federal government policies and/or regulations, which affect the proposed gasification plant's process selection, site, economics, financing, environmental control and, ultimately, its feasibility.

As an essential part of the feasibility study, the Montana Task Force on Coal Gasification, and the Montana Trade Commission, established and maintain a close working relationship with the Montana congressional delegation and appropriate federal agencies relative to Montana's energy needs. In this way, federal support has been solicited and information exchanged with regard to foreign relations and negotiations, federal funding opportunities and federal legislation and regulations.

Funding from the Federal Energy Administration and Economic Development Administration have contributed, in part, to support of the feasibility study.

Public Concern Activity Area

A continuing debate over coal extraction and utilization (energy generation) has catalyzed public interest and brought forth expressions of public concern over the continuing, and potentially expanding, consumption of this Montana resource. Various tactics have been used by a number of special interest groups in attempts to convince the public that coal extraction and/or energy development is, or is not, desirable, depending upon their viewpoint and/or bias.

In response, in part, to this situation the Governor of Montana created a Citizen's Advisory Council on Energy (CACE) to enable the people of the state, through these representatives and the support of the Governor, to investigate, evaluate and provide inputs to state energy policies and energy development within the state.

CONCLUSIONS AND RECOMMENDATIONS

Completion of the several activities of the coal gasification feasibility study has resulted in a number of conclusions and recommendations.

Conclusions

Two interrelated, general conclusions result from the coal gasification feasibility study:

- If initiated in a timely manner, with Federal assistance, construction and operation of a properly-sized coal gasification plant in Montana could be technically and economically feasible.
- Together with conservation of energy resources and maximum economic development of in-state natural gas resources, this plant can provide a viable solution to the natural gas supply problem in Montana which could become critical in the 1985-1900 time-frame.

These overall conclusions are derived from the results and conclusions of the major activity areas of the study which are summarized below:

- Technical risks of the candidate coal gasification processes present difficulties; however, this risk can be minimized.
- Financing of a coal gasification plant by a combination of federal, state and private sector funds is potentially viable.
- Synthetic natural gas (SNG) cost could be competitive with the costs of other energy sources. Sufficient demand will exist for SNG and by-products to make a plant economically viable.
- A coal gasification plant in Montana can be designed to be environmentally acceptable.
- A coal gasification plant will have minimal impact on the recommended candidate plant location--Glasgow AFB.
- Proposed legislation will provide for state control of the gasification project and protection of state interests in assuring adequate supplies of necessary fuels.

Conclusions of each of the feasibility study major activity areas are summarized below.

TECHNICAL ACTIVITY AREA

Process Evaluation

Based upon technical, economic, environmental and political factors, the following two coal gasification processes achieved the highest overall evaluation rating in the order shown:

1. LURGI

2. HYGAS

The overall evaluation ratings for these two processes are so close that it is difficult to make a definitive selection of a single process.

The first generation LURGI process is a commercially demonstrated, low-risk process with a relatively high overall thermal efficiency and low gas cost.

The second generation HYGAS process has been demonstrated on a pilot-plant scale. Its overall thermal efficiency is the highest of all processes evaluated and its capital and gas cost the lowest. A process description and capital and operating cost estimates for an 85 MMSCFD facility utilizing the HYGAS process are contained in Appendix A.

Economic Analysis

Annual natural gas demand in Montana is estimated to decline from the present level of 75-80 billion cubic feet (BCF) to approximately 61 BCF in 1985, rise to a peak slightly less than 70 BCF during the mid-1990's and decline again to 55-60 BCF by the year 2000. This projected demand is based upon firm (currently underway and scheduled for completion by 1980) and extrapolated (a function of relative fuel costs and payback period for

conversion) industrial energy substitution. The projection is probably a maximum or "upper-bound" estimate. Inter-fuel substitution for heating in the residential and commercial sectors was not included, nor was conservation in the commercial sector. As the price of natural gas increases in the future, these factors may become important and the demand further reduced. The impact of these variables cannot be quantified at the present time. The price of gas was assumed to rise to $4.60 per thousand cubic feet (MCF) by the year 2000 for the above demand estimate.

Although a decreasing demand is projected, the "most likely" projections still indicate an annual Montana natural gas consumption of approximately 55-60 billion cubic feet in the year 2000. This is a significant requirement. It is equal to two-thirds of the present total state annual demand, or more than the current total annual demand for central and western Montana.

FINANCIAL ACTIVITY AREA

Preliminary financing plans for 85 MMSCFD HYGAS and Lurgi coal gasification plants located at Glasgow Air Force Base were completed. Different plans for each of the processes were necessary because of the difference in the status of the two technologies.

Tax exempt revenue bond financing, with a structure of typical municipal revenue bonds, was chosen for consideration. The bonds would not have the full faith and credit pledge of the state, but would be paid off out of revenues of the project.

Due to the magnitude of the project, its capital intensity and its operating uncertainties, it is imperative that completion of the project be assured, and economic operation demonstrated. Completion and economic operation are essential because the basic financial credit involved in the project is the ability of the project to produce at high rates of capacity, as well as the ability to sell the output of the plant at a price sufficient to pay all costs of operation, maintenance and debt service.

LEGAL ACTIVITY AREA

The State of Montana has the constitutional power to participate in joint ventures such as that considered for the proposed coal gasiifcation project; however, it lacks the statutory authority. A proposed legislative act, the Montana Coal Gasification and Related Fuels Research Act of 1977, has been prepared in draft form for consideration by the 1977 session of the Montana Legislature. This legislation would create and fund the Commission to pursue federal support of the design of a demonstration-scale HYGAS plant, and perform certain other coal gasification related tasks, but would defer a final state commitment on plant construction and supporting bond issue.

SITE ACTIVITY AREA

Evaluation of the merits of siting the proposed Montana coal gasification facility at a mine-mouth location versus a location currently possessing an infrastructure, but located

in an area relatively remote to coal and water resources, primarily requires consideration of the following three factors:

Coal resources - quantity, location, ownership, availability and transportation

Water resources - quantity, location, ownership, availability and transportation

Infrastructure - community population and facilities required to service plant construction and operation.

The abundant coal resources of northeastern Montana focused the site selection study on that area of the state. Mine-mouth locations at Plentywood (Sheridan Co.), Poplar (Roosevelt Co.) and New Town (to be located in McCone Co.) were chosen and used for comparison with the existing infrastructure at Glasgow Air Force Base (GAFB).

Coal reserves sufficient for long-term supply of a coal gasification plant (up to a 250 MMscfd commercial size facility) exist within a 100-mile radius of all candidate plant sites. The surface and subsurface ownership of, and mineral rights for, this coal is divided among a number of organizations in the public and private sectors, and is very diversified geographically. The economic accessibility (over-burden and seam depth) and chemical composition of coal deposits vary for the coal fields considered as potential feedstock; however, these factors do not appear to be constraints on their availability as sources.

Based upon the amount of coal to be transported, the distance to be transported and existing legislative constraints, transportation via unit train has an advantage over slurry pipelines.

From the standpoint of physical availability, more than sufficient water is available from either the Fort Peck reservoir or the Missouri River to supply maximum water needs of a coal gasification facility and, in addition, provide irrigation of presently unirrigated land, if appropriate. Questions regarding the legal availability of the water, the right to transport water across the C. M. Russell game range, regional water requirements and priorities and the rights of downstream users need to be reviewed.

Using a criteria of achieving a positive sociological and economic impact, statistical analyses indicate Glasgow Air Force Base is the optimum choice for plant location. Of the sites reviewed, only this location possesses the community infrastructure capable of handling the required support.

Recommendations

The Montana Task Force on Coal Gasification approves the Coal Gasification Feasibility Study final report and endorses its two interrelated, general conclusions:

1. If initiated in a timely manner, with federal assistance, construction and operation of a properly-sized coal gasification plant in Montana could be technically and economically feasible.

2. Together with conservation of energy resources and maximum economic development of in-state natural gas resources, this plant can provide a viable solution to the natural gas supply problem in Montana which could become critical in the 1985-1990 time-frame.

In order to translate these conclusions into timely, effective action as a part of the overall solution to the impending critical natural gas supply problem confronting the State of Montana, the Task Force presents the following recommendations for consideration and action by appropriate decision-making bodies of the state.

1. It is recommended the Montana Coal Gasification and Related Fuels Research Act of 1977 be introduced to the Legislature and approved by the Governor.

2. It is recommended that, upon enactment and approval of this legislation, the Commission therein described be expeditiously appointed and provided with an annual budget of $196,500. (See Appendix B)

3. It is recommended that the Commission initiate concerted study of the Montana coal gasification project based upon the results and conclusions of the Coal Gasification Feasibility Study and, as a first priority, pursue the acquisition of federal funds for the design of a demonstration-scale HYGAS process coal-gasification plant to be located in Montana.

4. It is further recommended that the State of Montana simultaneously initiate:

   - An agressive conservation program that is designed to decrease consumption by increasing the efficient utilization of natural gas

- A study to analyze methods for stimulating exploration and development of intra-state natural gas reserves

- Supportive efforts of the Artic Gas Corporation's Alaska McKenzie Delta Pipeline. Cognizance should be maintained on the capital and product costs of this system.

The Montana Task Force on Coal Gasification further recommends that, pending the implementation of the recommendations described above, the government of the state of Montana endorse and support on-going efforts of the Task Force and the Montana Trade Commission and its consultants, to seek federal support of the Montana coal gasification project, until such time as an orderly transfer of information can be accomplished with the created Commission.

APPENDIX A

HYGAS PROCESS DESCRIPTION AND COST ESTIMATES

The HYGAS gasifier consists of a vertical shell containing four gas-solid contacting stages, internally connected by transfer lines. The four sections from top to bottom are: slurry drying, first-stage hydrogasification, second-stage hydrogasification, and steam-oxygen gasification.

The feed lignite is introduced into the gasifier in the form of a lignite-water slurry. The water is driven off in the slurry drying section with gases leaving the stages below. In the first- and second-stage hydrogasification, the carbon-hydrogen reaction is promoted to produce methane exothermally. This heat is utilized to decompose steam or carbon to produce hydrogen in addition to that produced in the steam-oxygen gasification section, where char leaving the second hydrogasification stage is gasified in the presence of steam and oxygen. Ash is removed from the bottom and sent to disposal. The methane-rich gases formed leave the gasifier at the top. Two gasifiers with 13 feet maximum internal diameter and about 215 feet height are needed to produce the 85 MMSCFD of SNG.

The lignite dried to 10 percent moisture is crushed to minus 8 mesh. Flue gas from a coal-fired heater provides the heat for lignite drying and the gas leaving the dryer is treated for SO_2 removal before being released to the

atmosphere. The processed lignite is then mixed with water, producing a 53 percent solids slurry. The slurry is heated to 570° F. in an external heater, and pumped into the gasifier. Simultaneously, oxygen at 370° F. and superheated steam at 1000° F. are fed into the steam-oxygen section of the gasifier.

The raw product gas, after drying the feed slurry, exits the top of the gasifier at 600° F. This raw gas is water quenched at 465° F. prior to CO shifting. In the shift reactor, a high sulfur cobalt-moly catalyst is used, thus eliminating the need for H_2S removal before shifting, and consequently, eliminating the need for cooling the gas down below 465° F. The quenched gas is split into two streams: 60 percent of the gas passes through the shift reactors while the remainder is bypassed. These streams are recombined after the shift and cooled down to 100° F. by generating steam and by indirect contact with cooling water. A BTX fraction condenses out of the gas and is recovered as a by-product. Ammonia in the gas also comes out in the condensed water. The water is processed and distilled to recover anhydrous ammonia.

The cooled gas enters a Selexol system in which essentially all of the H_2S and CO_2 are removed from the feed gas. This acid gas stream is sent to a Stretford plant where elemental sulfur is recovered as a by-product. The purified gas exits the acid gas absorber at 100° F. and 1145 psig.

The feed to methanation contains hydrogen and carbon monoxide in a 3.1:1 ratio. In the methanation step, 99.5 percent of the CO in the feed gas is converted to methane. The resulting SNG is then dehydrated in a glycol dehydration unit. Compression is not required because the gas is available at the specified 1000 psig pressure. Surge bottles are provided on the product gas line to smooth out minor process upsets.

Capital Cost Estimate

Description	MM $
Coal Unloading and Handling	9.4
Gasification	66.0
Raw Gas Quench	10.2
Shift Conversion	11.8
Gas Cooling	4.2
Acid Gas Removal	10.9
Methanation	12.9
Glycol Dehydration	1.2
Oxygen Plant	34.0
Stretford Plant	5.2
Primary Water Treatment	4.3
Bio Treatment	7.4
Demineralization & Deaeration	1.6
Cooling Water System	4.4
Treatment, Disposal & Evaporation	1.4
Sanitary Waste Disposal	0.2
Flare & Thermal Oxidizer	1.1
Emergency Power Generation	2.8
Plant Air & Instrument Air	1.0
Gas Surge	1.1
Fire Protection System	.4
Boiler	5.4
SO_2 Removal	6.6
Offsites	20.6
TOTAL	224.1
Project Contingency + General & Administrative Expense + Engineering Supervision	26.9
Process Contingency (5%) for Gasification	3.3
TOTAL PLANT INVESTMENT	254.3
Interest During Construction	49.6
Start-Up Costs	13.5
TOTAL FIXED INVESTMENT	317.4
Working Capital	10.2
TOTAL CAPITAL REQUIREMENT	327.6

		MM $/YR.	$/MM BTU
Coal		23.30	0.83
OPERATING COSTS			
Catalyst & Chemicals:	1.57		
Purchased Utilities:			
Electricity:	2.49		
Water:	0.003		
Labor			
Direct Operating:	3.33		
Maintenance:	3.81		
Supervision:	1.07		
Admin. & Gen. Overhead:	4.93		
Supplies:	4.81		
TOTAL:		22.01	0.78
By-Product Credit:		(12.17)	(0.43)
CAPITAL COSTS:			
Local Taxes & Insurance:	6.9		
Depreciation:	15.9		
Average Return:	17.7		
Average Federal Income Tax:	5.8		
TOTAL:		46.30	1.64
TOTAL REVENUE REQUIREMENT:		79.44	2.82

APPENDIX B

A DESCRIPTION OF THE MONTANA COAL GASIFICATION COMMISSION

Commission Members

Governor, State of Montana
Lt. Governor, State of Montana
Director, Department of Natural Resources and Conservation
Representative of Agriculture
Representative of Utilities Industry
Representative of Labor
Member of Public at Large

Administration

Administrator

The Administrator of the Commission shall have professional ability and proven expertise in industrial related projects. He would be functionally independent of other state department administrations and shall execute all orders of the Commission. He shall keep the Commission fully advised as to the financial condition and needs of the Commission's projects. Additionally, he will be responsible for presenting project status reports. He will see that the laws, rules and regulations pertaining to matters within the scope of his responsibilities are carried out or enforced. He shall prepare in each year an expense

and capital budget and revisions of the same for the ensuing fiscal year. He shall recommend what construction, reconstruction, improvements and extensions, if any, should be made during the ensuing fiscal year. He shall recommend to the Commission the salaries or wages to be paid the Commission's employees. He shall hire and discharge employees under his direction and shall perform all other duties imposed by the Commission. He shall direct all efforts engaged in by the Commission and shall serve at the pleasure of the Commission.

Assistant Administrator

The Assistant Administrator shall advise, and counsel the Administrator on Activities engaged in by the Commission. He shall be responsible for the actions of consultants and coordinate research programs. He shall possess experience and expertise in project management functions and shall maintain professional cognizance over the programs in which he is engaged. He shall be directly responsible to the Administrator of the Commission and may attend all meetings of the Commission and its committees and may take part in the discussion of any matters within the scope of his functions.

Commission functions for next 24 months: Primarily an extension and continuation of present Task Force (Trade Commission) efforts:

Technical Activity Area

Process Evaluation

- Pursue federal support for HyGas. Monitor HyGas pilot plant program, possibly including long-duration run with candidate Montana lignite.
- Monitor federal programs and funding affecting Lurgi. (Synfuels, loan guarantees, etc.)
- Monitor other processes for break-throughs.

Economic Analysis

- Continue price-demand analysis, up-dating data, as appropriate.
- Obtain preliminary commitments of sponsors for joint venture.
- Obtain product and by-product users preliminary commitments.

Financial Activity Area

- Update financial plans for HyGas and Lurgi as conditions warrant.
- Monitor potential sponsors financial condition and bond market.

Legal Activity Area

- Monitor federal and state legislation for impact on project.
- Prepare Interim Report for legislative Committee.

Site Activity Area

- Refine and update site trade-off study.
- Monitor GAFB status.
- Pursue coal source selection as far as possible, short of signing contract for supply.
- Same for water source, plus defining what is required to obtain water rights, water pipeline right-of-way, etc.

Environmental Activity Area

- Pursue DOD funding for impact study or EIS.
- Monitor federal and state environmental legislation.

Federal Relations Activity Area

- Solicit congressional delegation and federal agencies support for Montana coal gasification project.

Public Concern Activity Area

- Disseminate Information on Developments occuring within natural gas area and gasification.

Work with new state energy agency (if formed) and other state agencies to get consensus on energy supply and demand problem. Attempt to get all state agencies moving in the same direction on solution to energy problem. By the end of the first year, the Commission should complete the following:

1. A solicited proposal for a HyGas plant in Montana (if applicable) or submission of an unsolicited proposal for same.
2. A project structure for the sponsorship of a Montana coal gasification project (unsolicited proposal) capable of

entering into contracts.

3. A firm plan for initiating a Lurgi process plant, if HyGas efforts fail.
4. An updated economic analysis showing the competitiveness of SNG (HyGas and/or Lurgi) with natural gas and other energy sources.
5. Preliminary commitments from potential project sponsors and product and by-products customers. (Required for 1, 2 and 3 above.)
6. If required, a draft of state legislation required for funding appropriation of continued Commission work and support of gasification project design.
7. Selection of gasification plant site (required for 1 and 3 above) and all preliminary work for acquisition of land coal and water.
8. Initiation of environmental impact study or EIS for project.

Costs

Personnel per year		
Administrator	25,000-35,000	30,000
Assistant Administrator	15,000-20,000	17,500
Secretary	8,000-10,000	9,000
Total Personnel	48,000-65,000	56,500
Consultants	60,000-80,000	70,000
Support Costs	60,000-80,000 120,000-160,000	70,000 140,000
Total 12 Mo. Cost	168,000-225,000	196,500